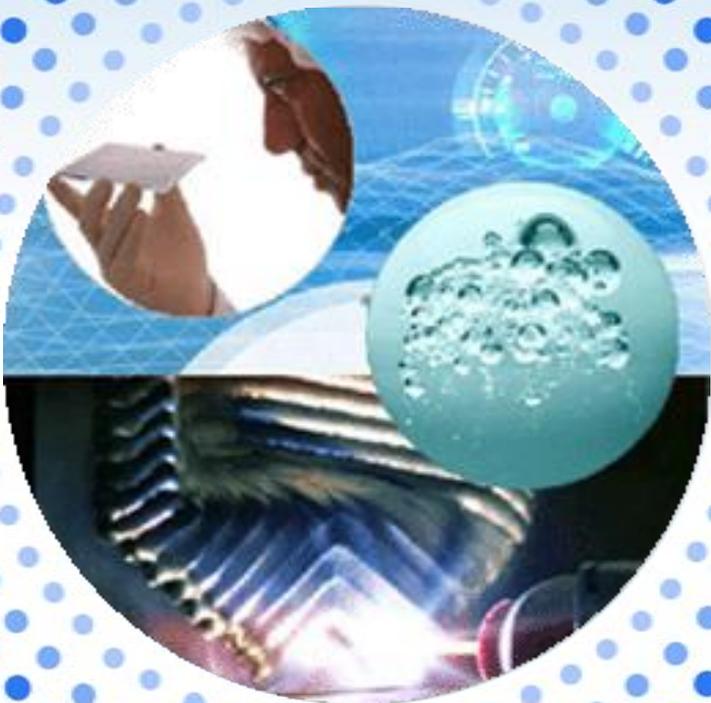


EDF Smart Grid development

Xavier MAMO
International Research Program Manager



The EDF Group at a glance



United Kingdom
EDF Energy (100 %)
1 distributor



Germany
EnBW (45 %)
3 German electricity utility



France
Capacity: 101 GW (63 GW nuclear)
Customers : 28m
Networks: 1 340 000 km
Gas: 3 bcm



Italy
Edison (50 %)
2 Italian utility (electricity+gas)

Revenues : € 59,6 billion
EBITDA : € 15,2 billion
Customers in the world : 37,8 million
Employees in the world : 156.500
Generation : 128,200 GW (installed capacity)
633 TWh (generation)

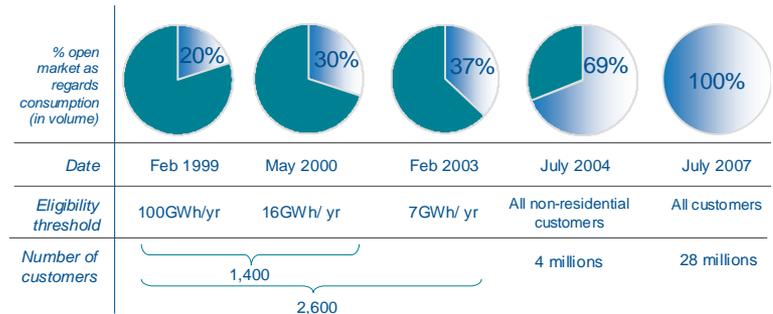
EDF Trading

Volumes handled: electricity (745 TWh)
Gas (116 bcm)
Coal (237 Mt)
Oil (141 Mb)



The electricity sector in France

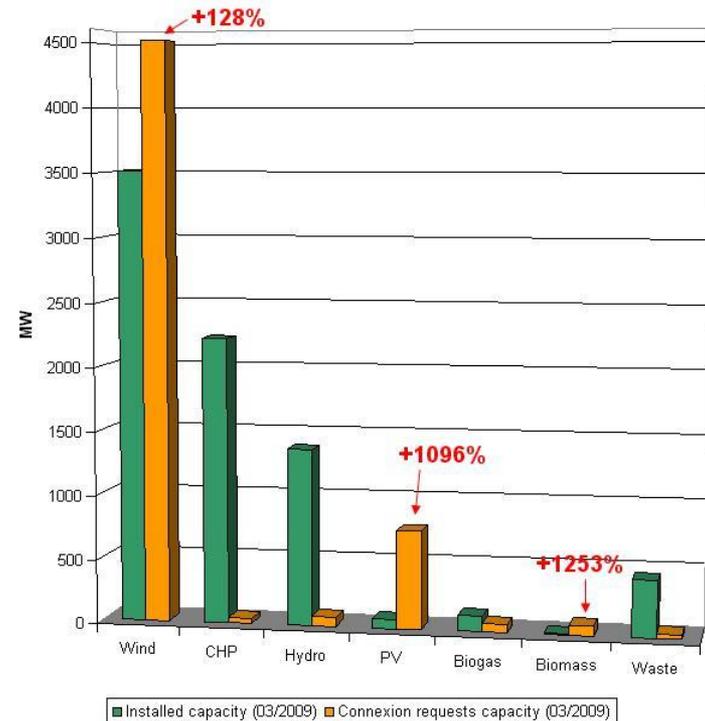
- ⊙ A fully open market since July 2007



- ⊙ A legal separation of T&D activities from those subject to competition (2003 European Directive)

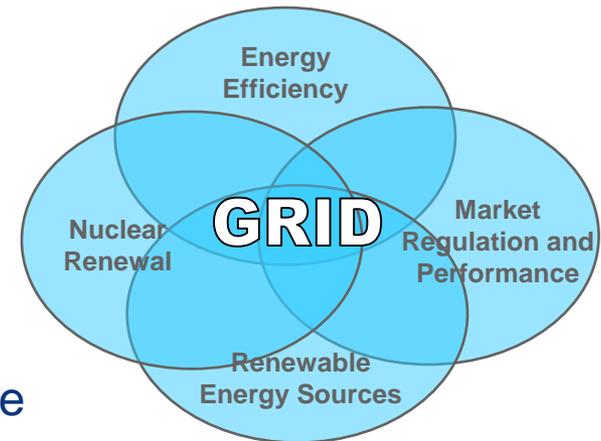


- ⊙ Development of renewable energy on distribution networks



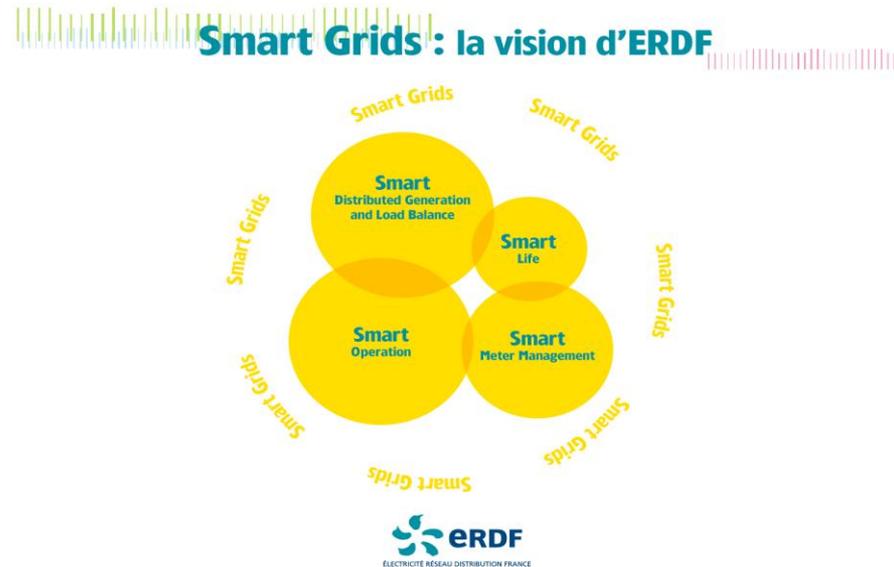
Context

- ⦿ Electricity considered as an energy vector for the future: increased focus on system power quality, reliability, security and costs
- ⦿ Climate change and environmental concern
 - ⦿ Drivers to develop renewable energy sources
 - ⦿ Drivers to develop energy efficiency
 - ⦿ Grid modernization is the cornerstone to enable more flexibility and adaptability
- ⦿ Lots of challenges for network operators: ageing assets, workforce renewal, regulation, ...
- ⦿ Economy crisis: public and local authorities supporting infrastructure investments including electricity networks to support economic recovery

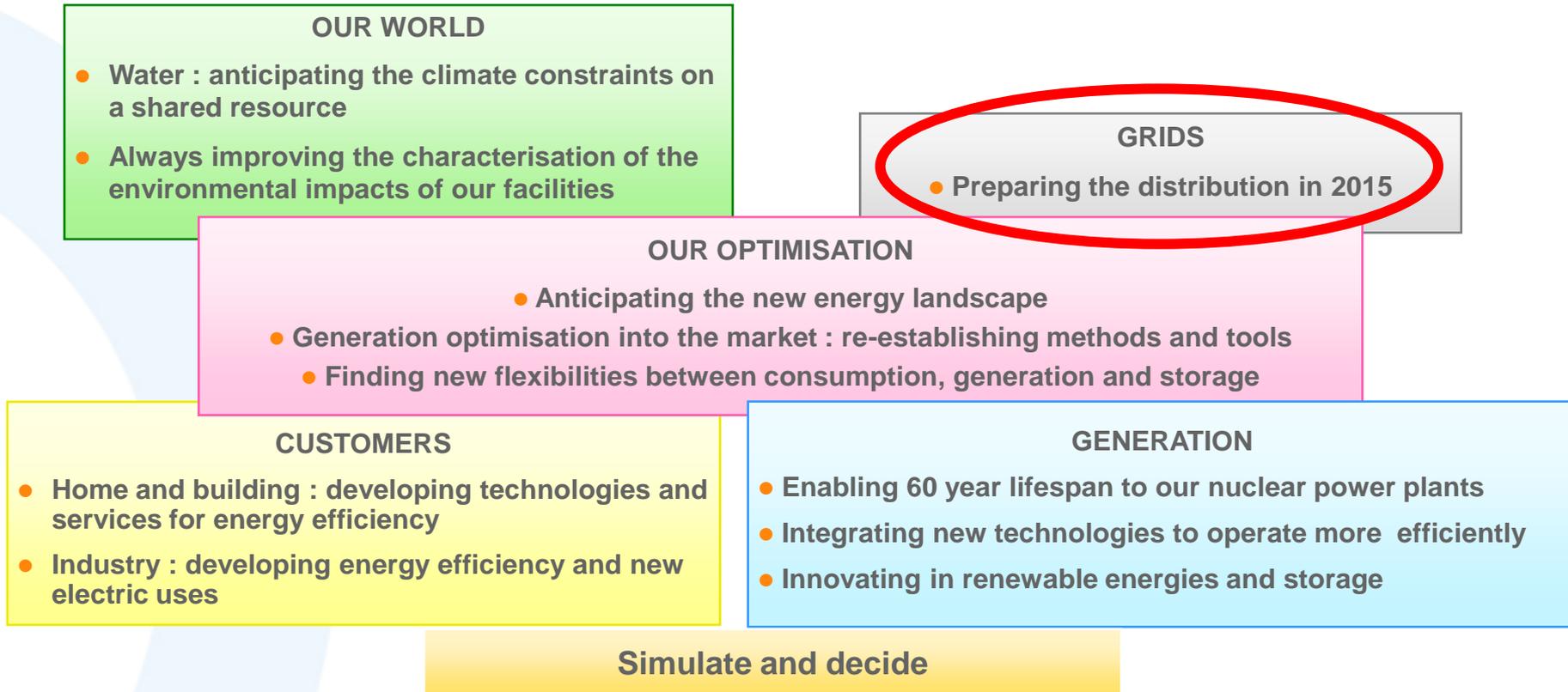


Smart Grid opportunities

- Ongoing Smart Grid research programs have identified the associated risks and opportunities for distribution systems
 - Ageing assets
 - Distributed Energy Resources integration
 - Standardization of data exchanges
 - Advanced operation and automation functions
 - Advanced metering
 - Communication and information technologies
- Remaining integration, sociological and regulatory barriers need to be solved via research demonstration programs
- Need to explore on the field existing and identified Smart Grid solutions on all aspects with the different stakeholders

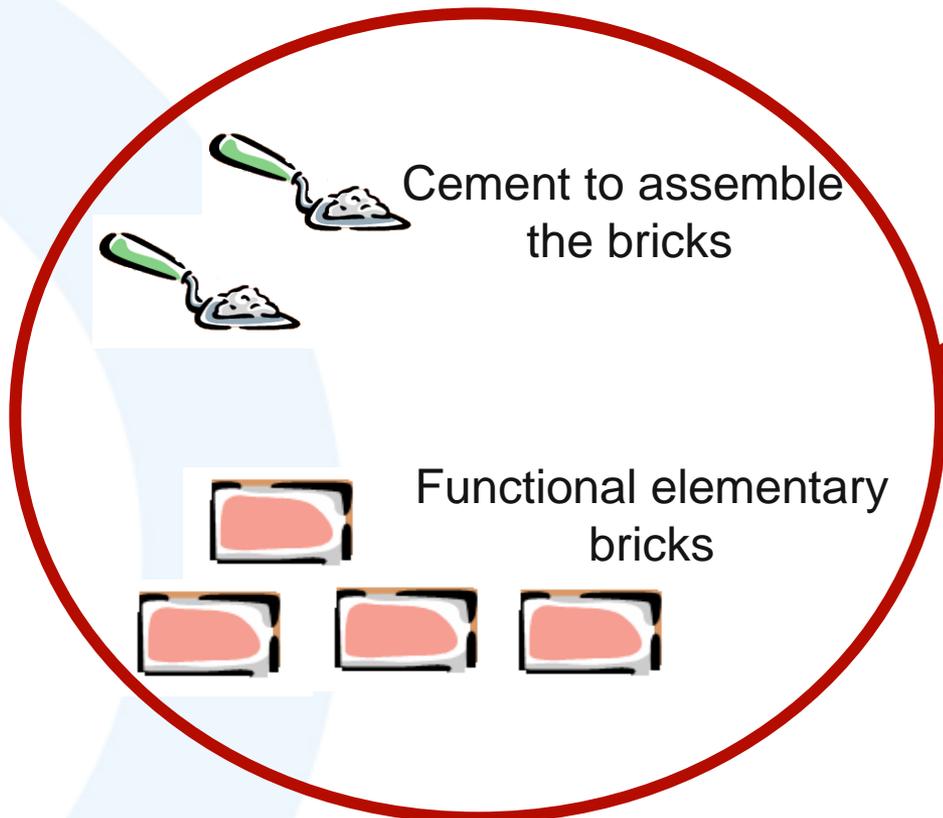


R&D: EDF Challenges 2007-2009



EDF R&D at a glance : 2,000 individuals, 375 million €/ year

Approach for Smart Grid Demos



Solar neighborhood



Urban network



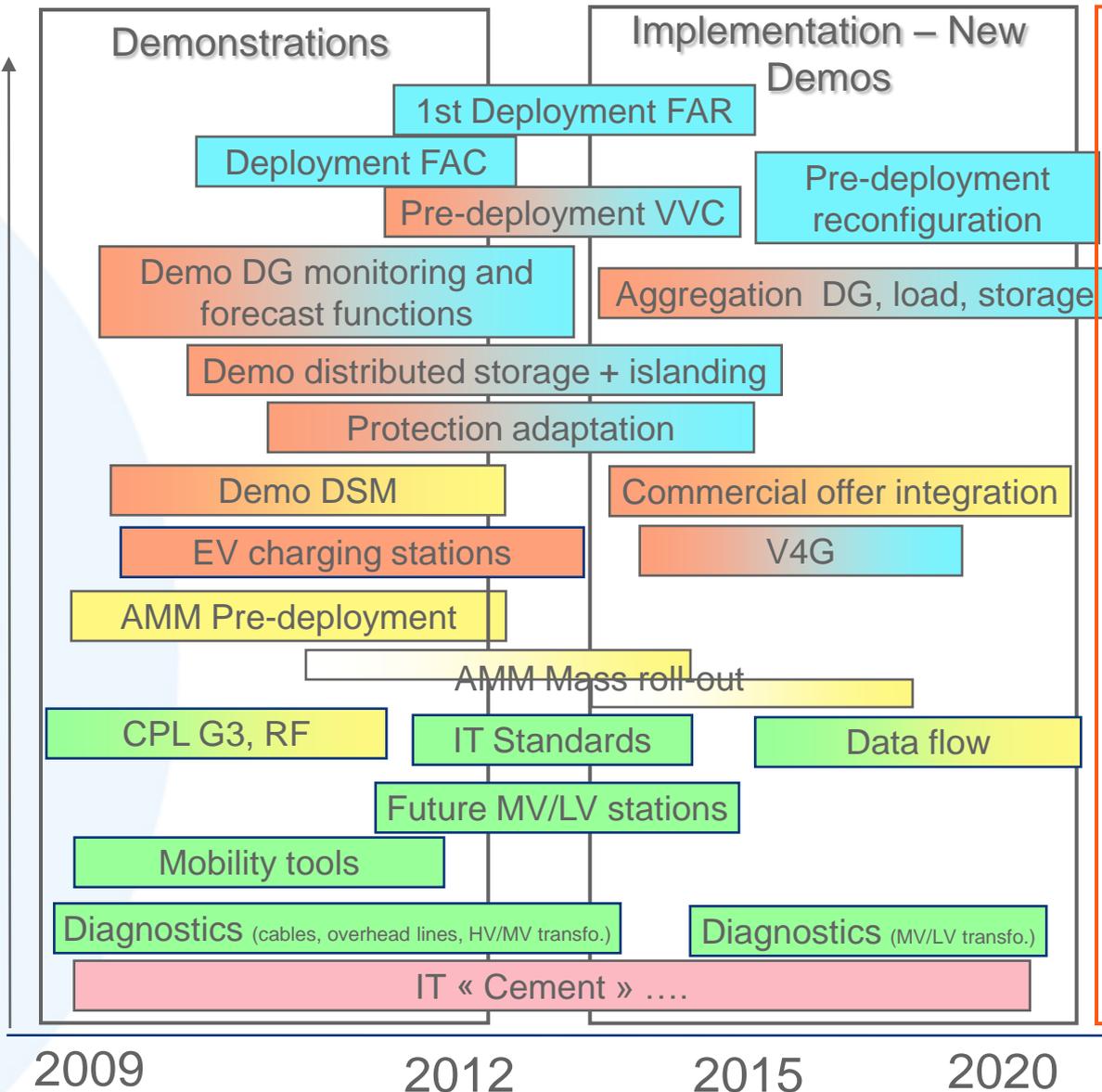
Rural network

Elementary functions...

Demonstrations ...

An integrated vision of the Smart Grid concept...

Technology roadmap

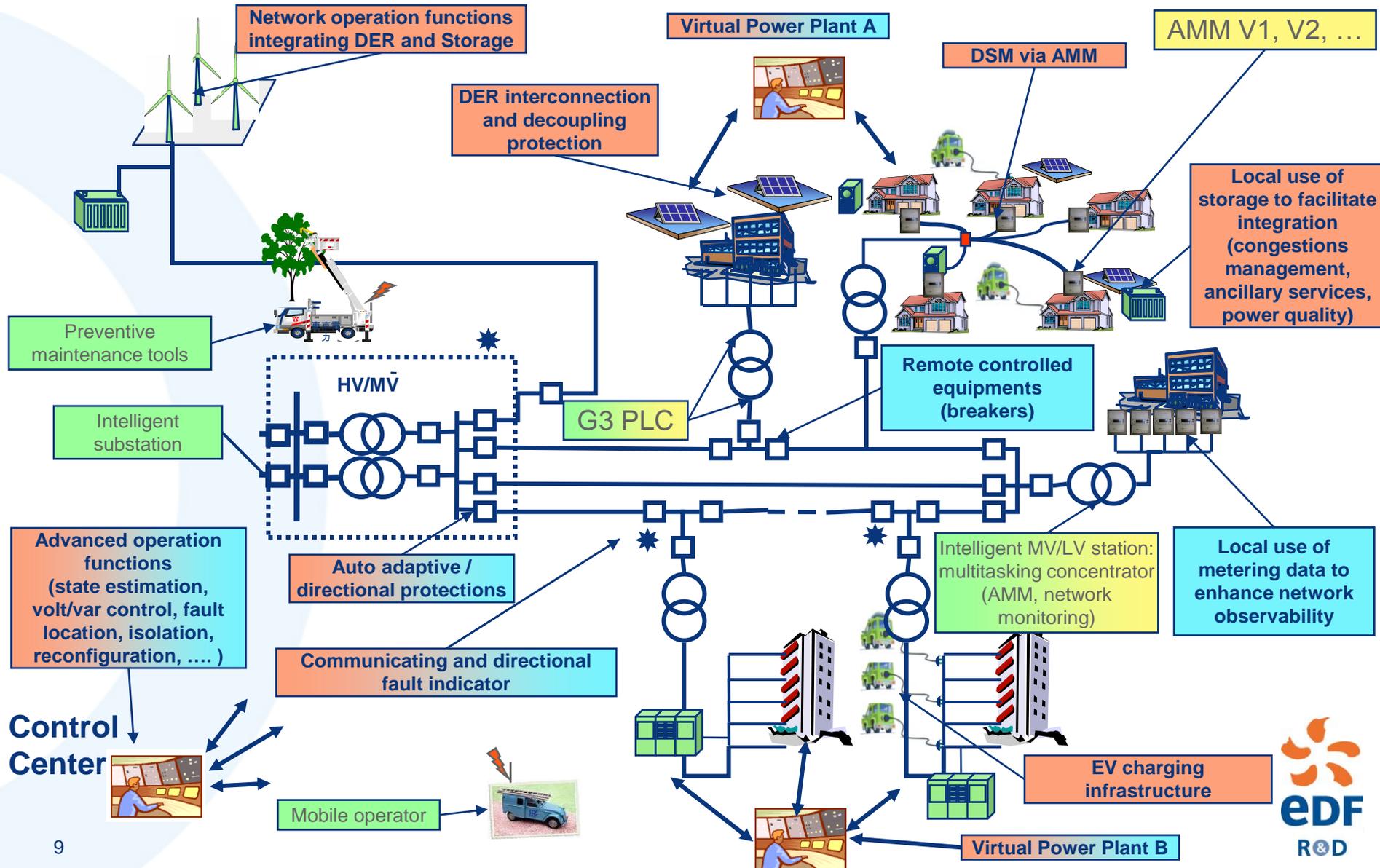


Targets

- Enhanced network control and operation thanks to more automation and better distributed intelligence
- Successful integration of distributed generation: costs and ancillary services
- Enhanced system flexibility, generation / consumption optimization
- Leveraging advanced metering infrastructure: less costs and more services
- High performing and flexible telecommunication tools
- Improved balance between system reliability, power quality and costs via more effective asset management

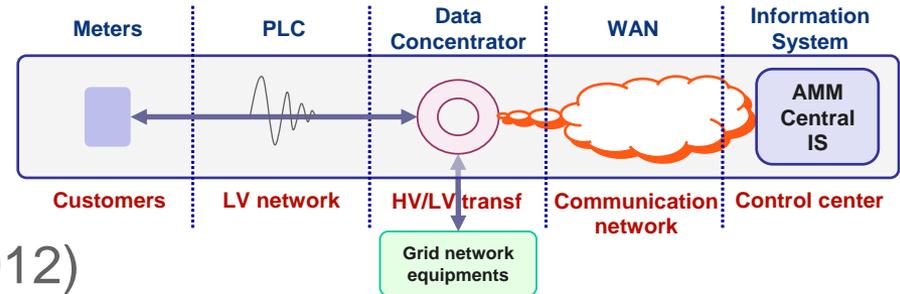


Candidate functions for demos



AMM Pilot project (ERDF)

- General system architecture



- To prepare the massive roll-out (2012)

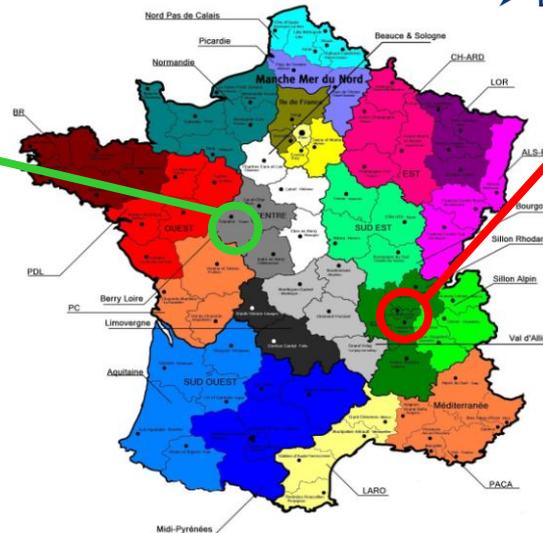
- 300 000 meters
- 7000 concentrators

Around Tours (100 000 customers)

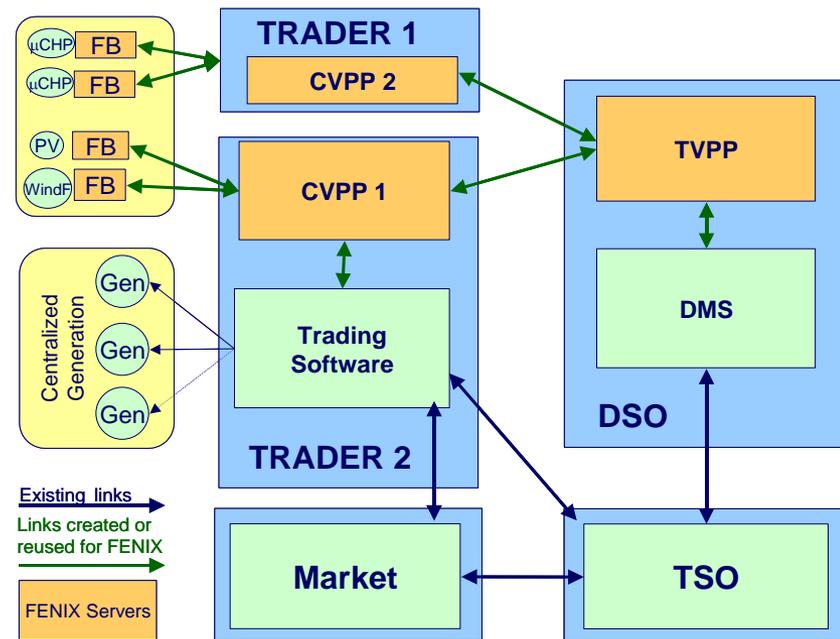
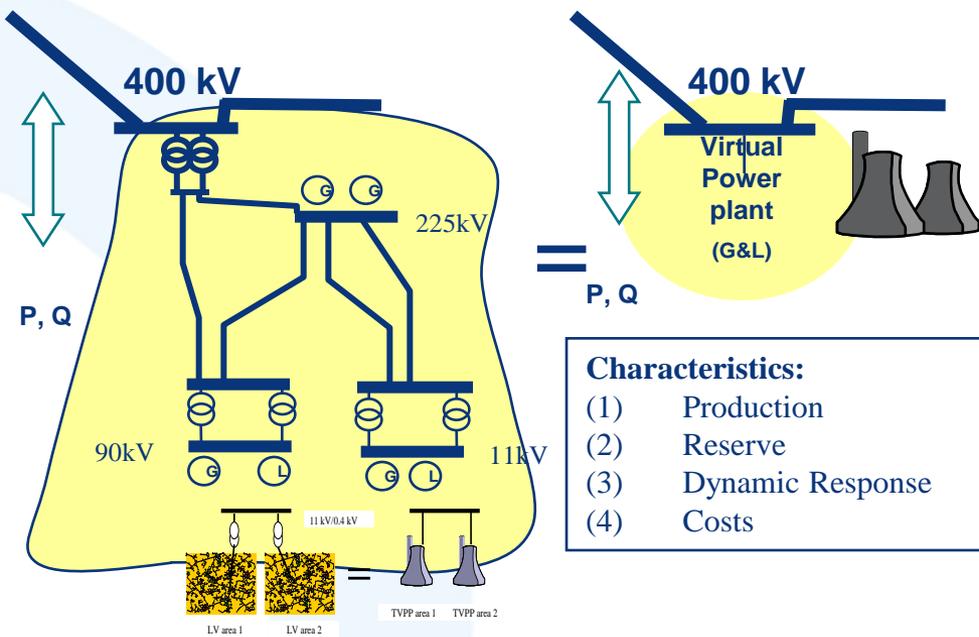
- Rural area,
- Pole mounted transformers,
- Overhead network,
- Villages, isolated houses
- Vacation houses

Around Lyon (200 000 customers)

- Urban area,
- Underground network,
- Underground sub-stations,
- Downtown area, Domestic high rises



From local energy sources aggregation...

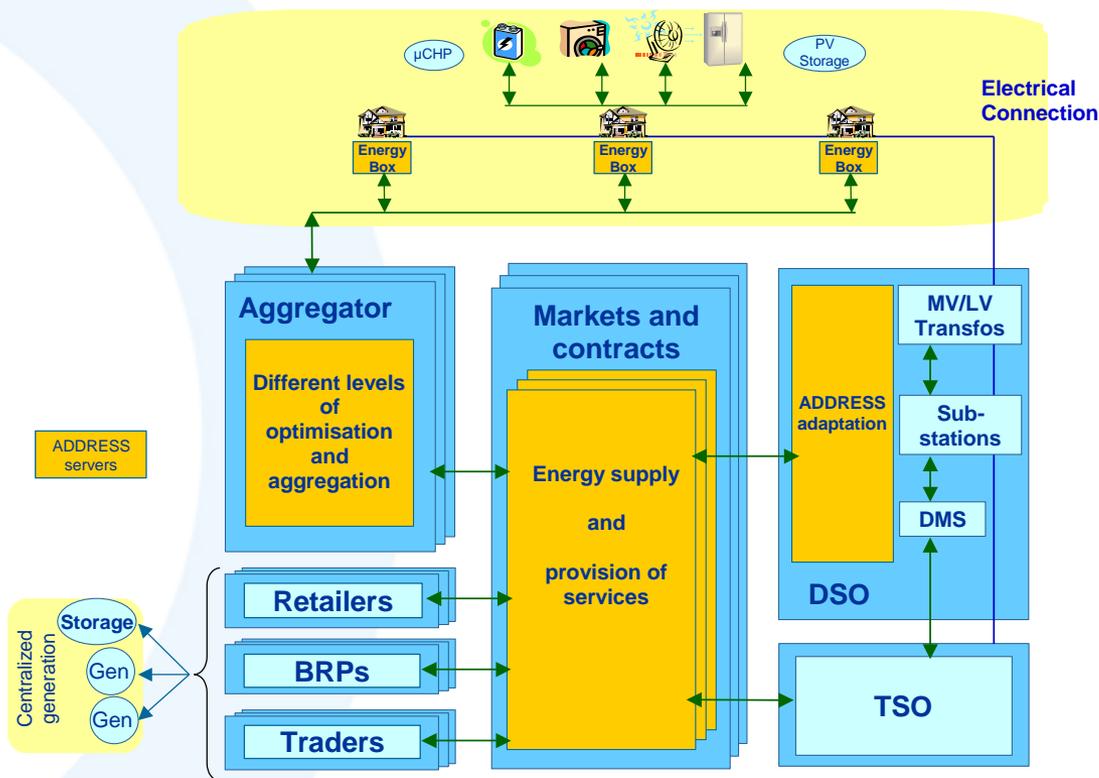


Local energy aggregation into « Virtual » Power Plants enable :

- To reach the necessary size to access to market to prepare the step following the actual political support to encourage renewable development ;
- To rise an infrastructure (data and communication) giving to network operators a tool to integrate this local production in the global and local system operation in a win win approach.

... to load aggregation

address - Active Distribution networks with full integration of Demand and distributed energy ResourceS (2008-2012)



Towards active loads :

Domestic and small tertiary customers participation providing services to electric system players

=> Contribution to the RES development and to their integration into the electrical system



address - Project co-financed by EC within the 7e RDFP

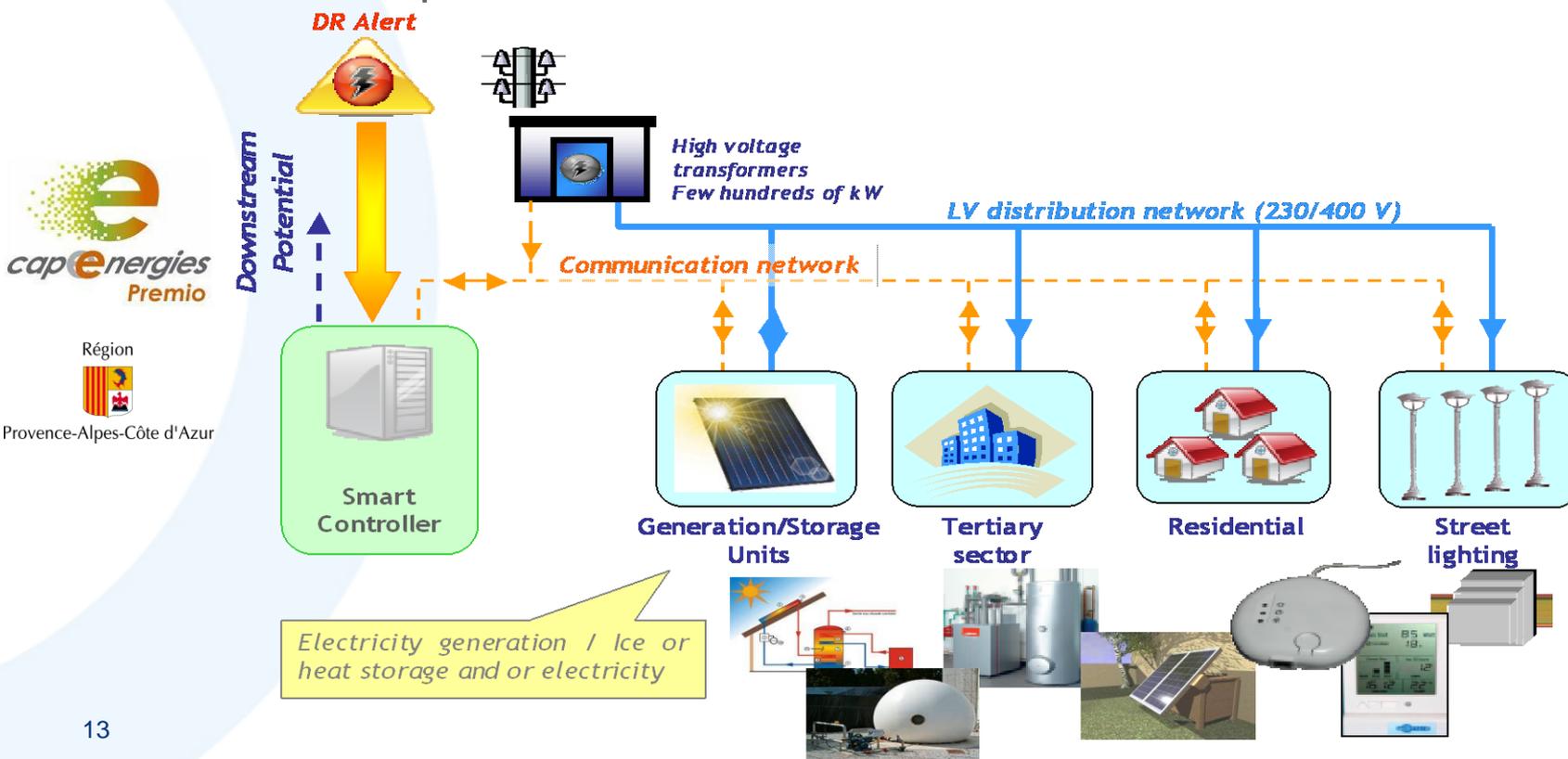


PREMIO: a demand response coordination example

General objective

- To demonstrate an innovative and replicable architecture (in the South of France) aimed at optimizing distributed generation, storage, renewable energy sources, demand response and energy efficiency measures and at reducing the constraints of a local grid and CO2 emissions

Technical scope



Complementary objectives



Enable **DER** to participate into the electricity supply system in a cost efficient, secure and sustainable way through aggregation into **Large Scale Virtual Power Plant (LSVPP)**

- Develop technical solutions to **integrate the LSVPP into the T&D network control** and information interface.
- Develop prototypes of new **EMS and DMS**.
- Design **commercial framework** to support system operation and quantify the costs and benefits of status quo and FENIX futures.

address

interactive energy



Project co-funded by the European Commission within the 7th Framework Programme

Active Demand (AD) = participation of **domestic and small commercial consumers** in markets and provision of services to power system participants

- Develop technical solutions to **enable active demand** both at consumer's premises and at power system level
- Design contractual and market mechanisms for the **exploitation of the benefits of AD**
- Propose **accompanying measures** for societal, cultural & behavioural aspects ...



Makes use of **communications, computing & power electronics** to create a system that is:

- Self-healing and adaptive**
- Interactive** with consumers and market
- Optimized** to make best use of resources and equipment
- Predictive** rather than reactive, to prevent emergencies
- Distributed** across geographical and organizational boundaries
- Integrated**, merging monitoring, control, protection, maintenance, EMS, DMS, marketing and IT
- More secure** from attack



Région



Provence-Alpes-Côte d'Azur

Local Energy management =

local dynamic management of electric generation and consumption to:

- Optimise local energy system** and achieve
 - energy savings** (reduction of the bill), better **integration of local DG**, storage and Renewable Energy Sources, **reduction of CO2 emissions**,
 - while taking into account **consumers comfort**
- React to DSM signals and solve local grids constraints**



Markets and Services



Local energy & load management
 ⇒ Services to consumers, aggregators, DSO, VPP, ...

Load shaping services (e.g. load shaving)

Local energy optimisation

address
 interactive energy



DR & EE* included in the capacity market
 Integration of RES and PHEV
 Secure & integrated information exchange infrastructure

+

+ Energy market
 Steady state V control
 Balancing services (incl. compensation of RES variability)
 Overload and network congestion relief

+

Dynamic Volt VAR Control



* DR: Demand Response, EE: Energy Efficiency



Conclusion

- ⊙ A favorable context and environment
 - Network as a bottleneck to be modernized
 - Strong political concern and push
- ⊙ Need for new research and demonstration initiatives
 - France: ongoing RFP for demonstrations (ADEME)
 - EU: ongoing activities in FP7
- ⊙ Enhanced collaboration and coordination needed to enable Smart Grid development
 - Between the local electricity system players
 - Between the ongoing worldwide initiatives



EDF Smart Grid development

Questions

Xavier MAMO

International Research
Program Manager

xavier.mamo@edf.fr

